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(54) **Weapon system for detecting and countering an aerial threat**

(57) The present invention comprises a system for detecting and countering an aerial threat comprising
- a carriage 1 which is rotatable about a central axis, on a shaft 11 by driving means,
- photosensitive means 22, 23, 24, preferably IR detectors disposed in the interior of the said carriage 1 and for observing the environment of the said system through at least one observation window 6, 7, 8 arranged in the peripheral external wall 5 of the said carriage 1,
- telemetric means 25, preferably a range finding laser, for measuring the distance separating the said system and the said threat, and means 26, preferably a blinding laser for attacking the said threat, the said telemetric means and the said attacking means being mounted in the said carriage 1,
- measuring means indicating at each instant the angular position of the said carriage (1) and
- processing means receiving the information delivered by the said photosensitive means, the said measuring means and the said telemetric means, and delivering orders to the said attacking means.

The device may rotate continuously about the axis of a self propelled missile or be mounted on the ground, a ship or a vehicle and oscillate back and forth.

FIG.3

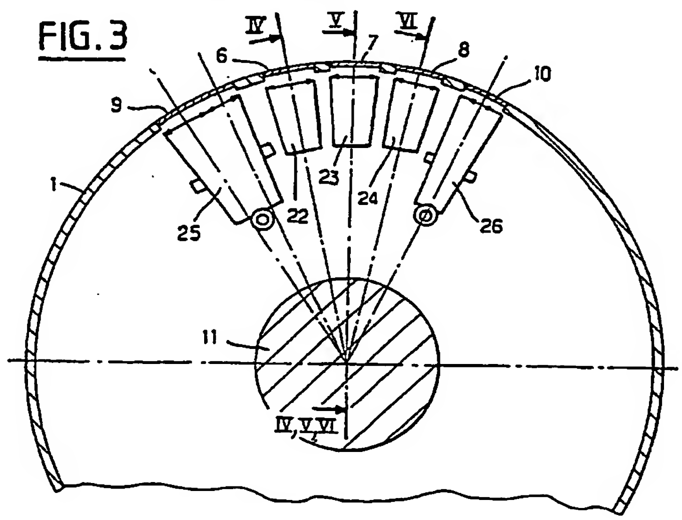

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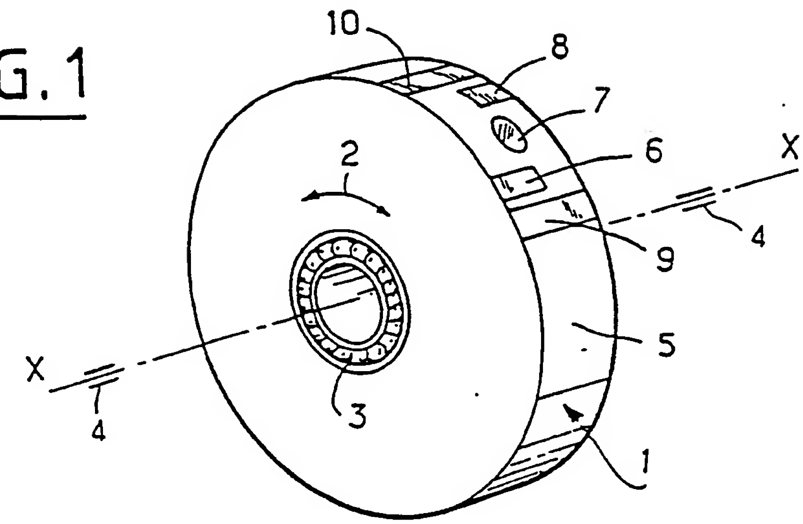
FIG. 1



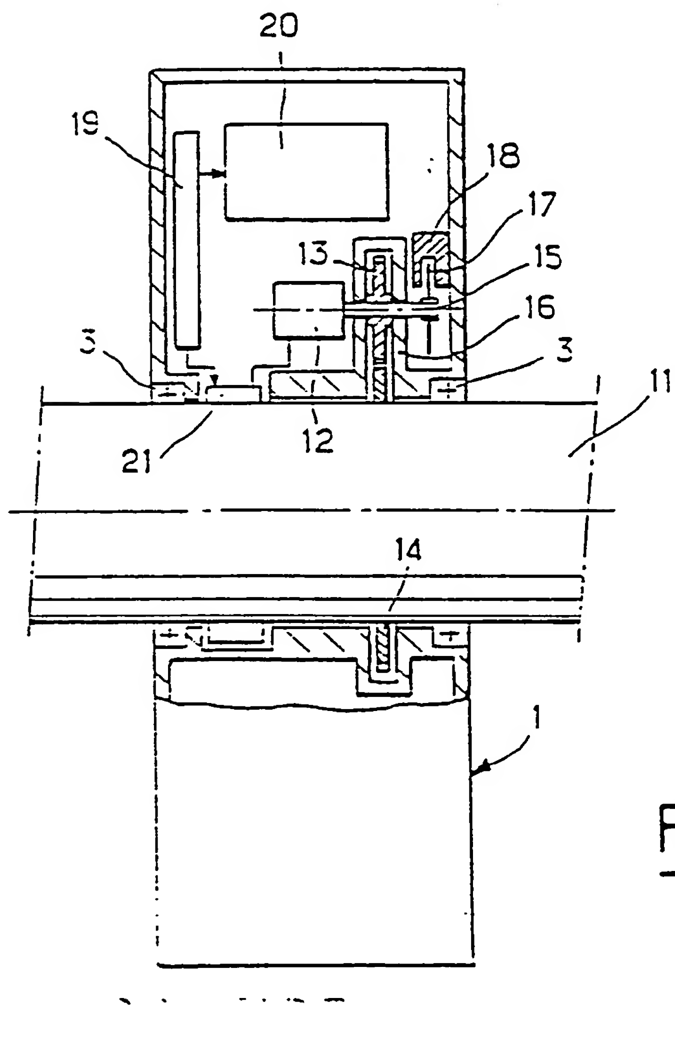
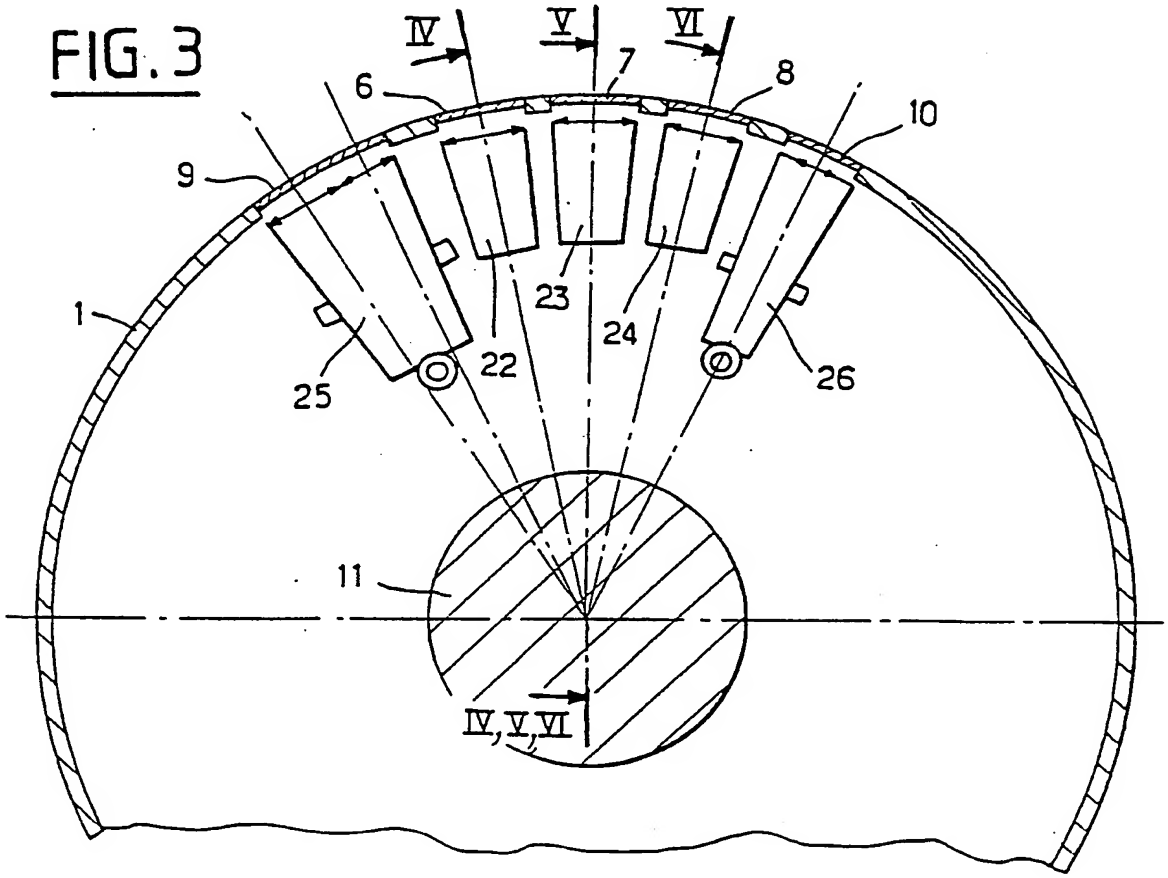


FIG. 2

FIG. 3



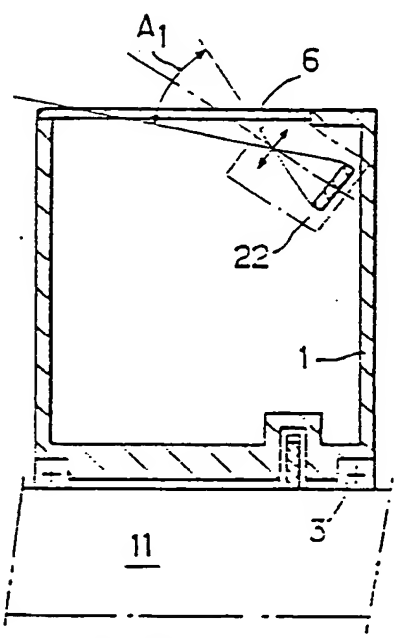


FIG. 4

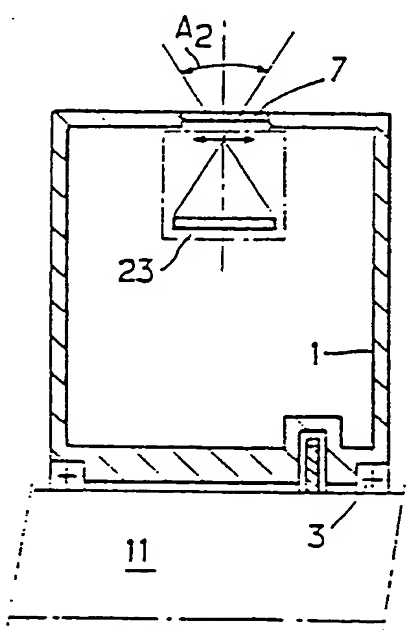


FIG. 5

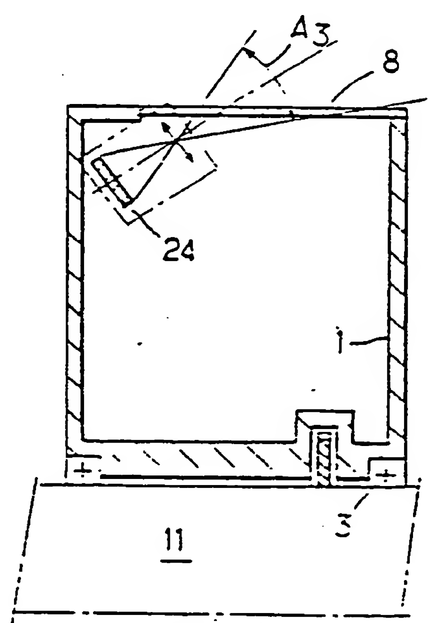


FIG. 6

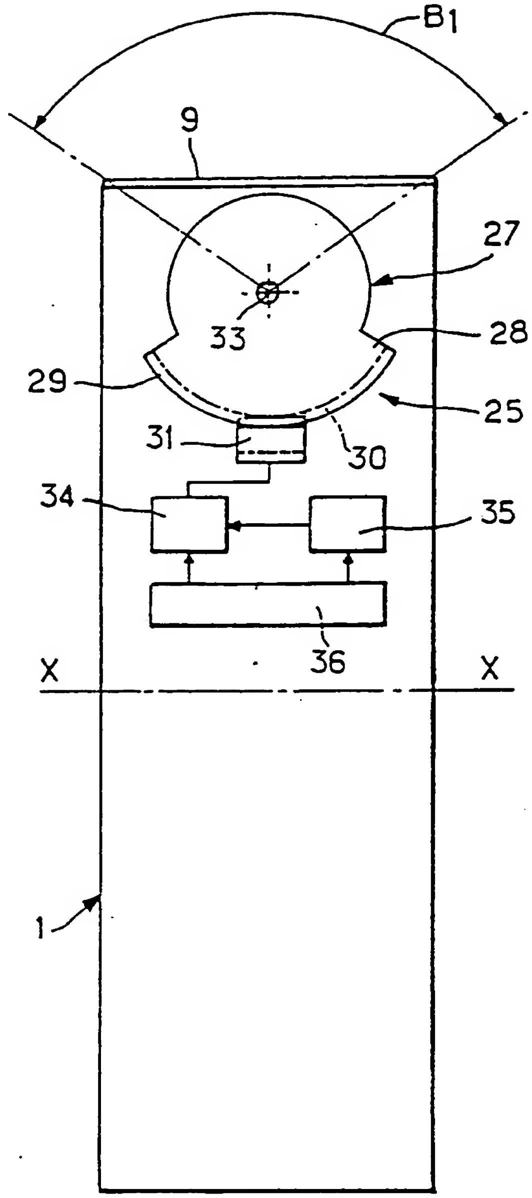


FIG.7a

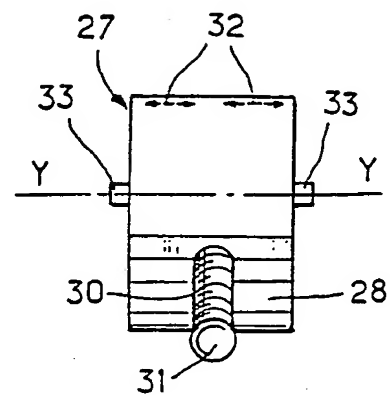


FIG.7b

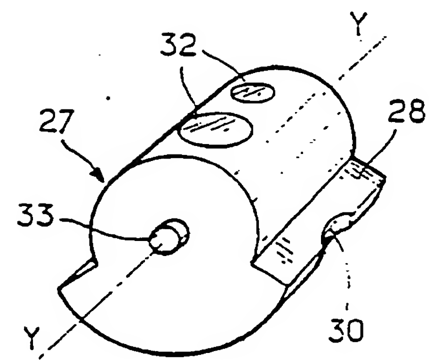


FIG.7d

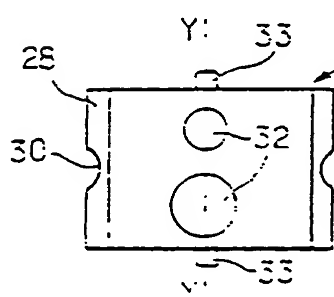


FIG.7c

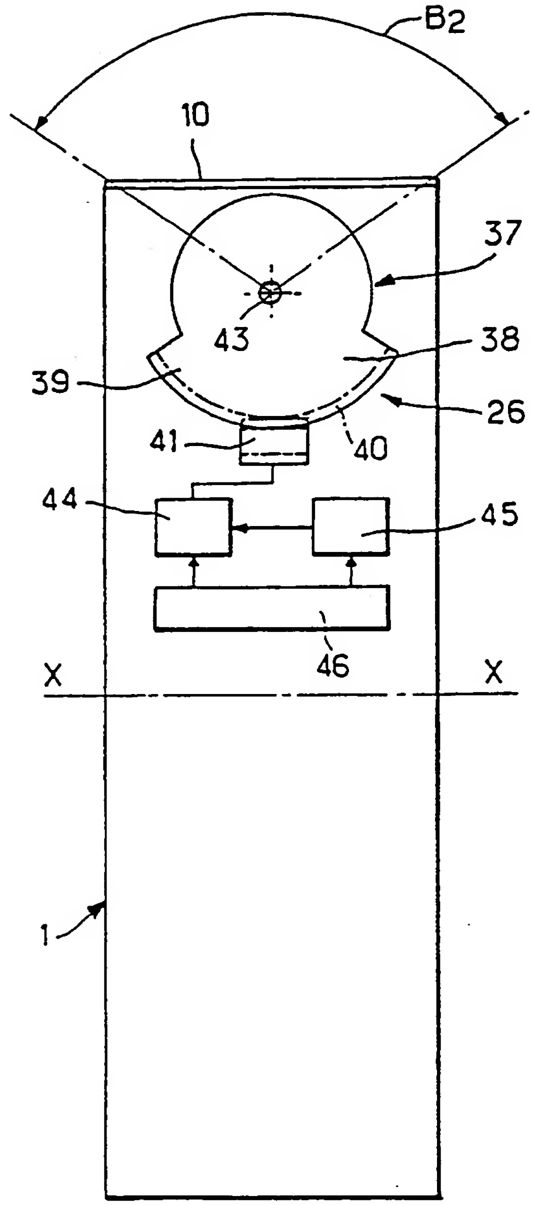


FIG. 8a

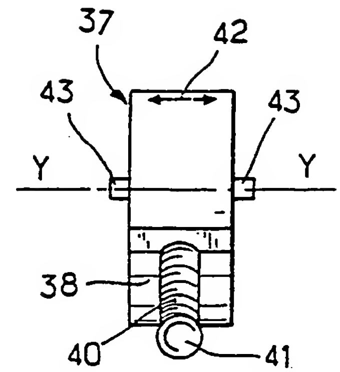


FIG. 8b

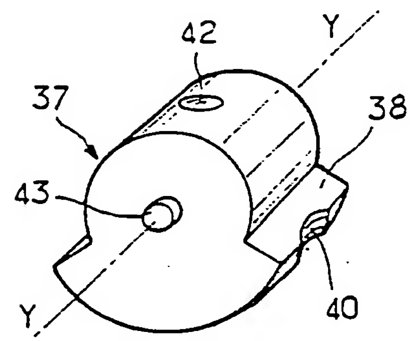


FIG. 8d

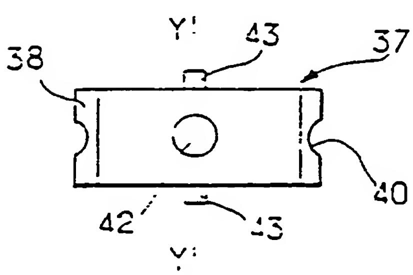
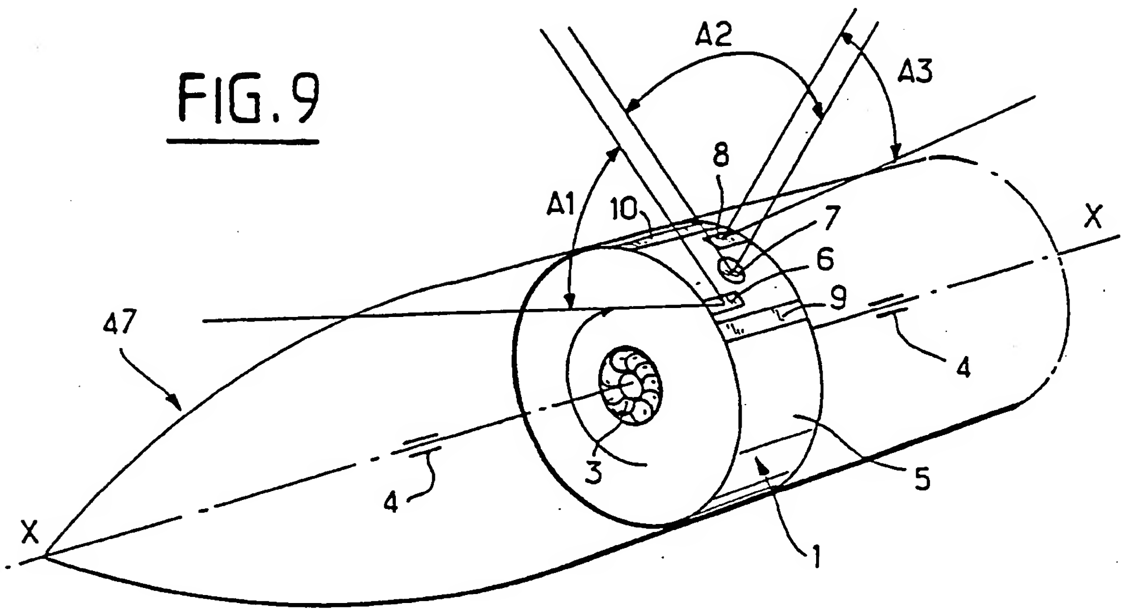


FIG. 8c

FIG.9



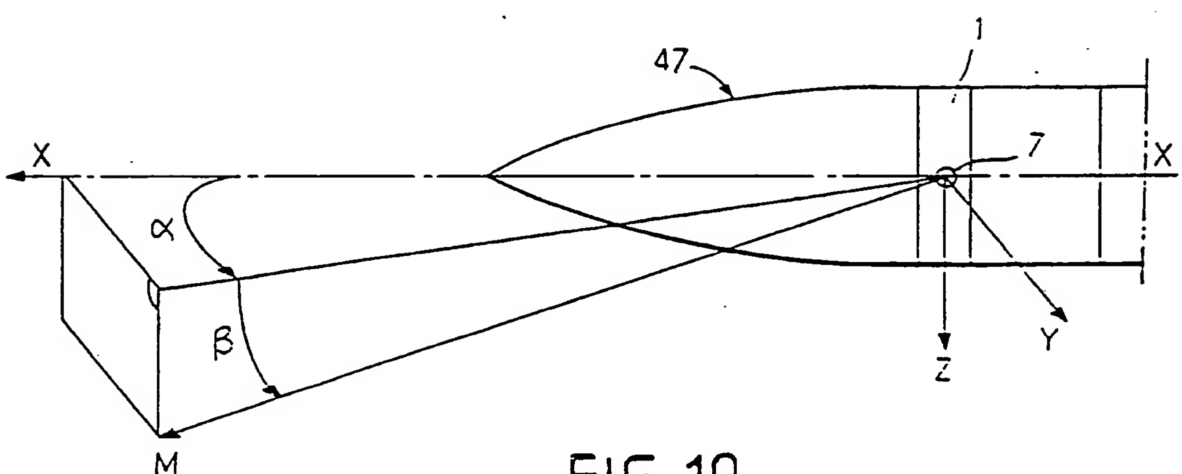
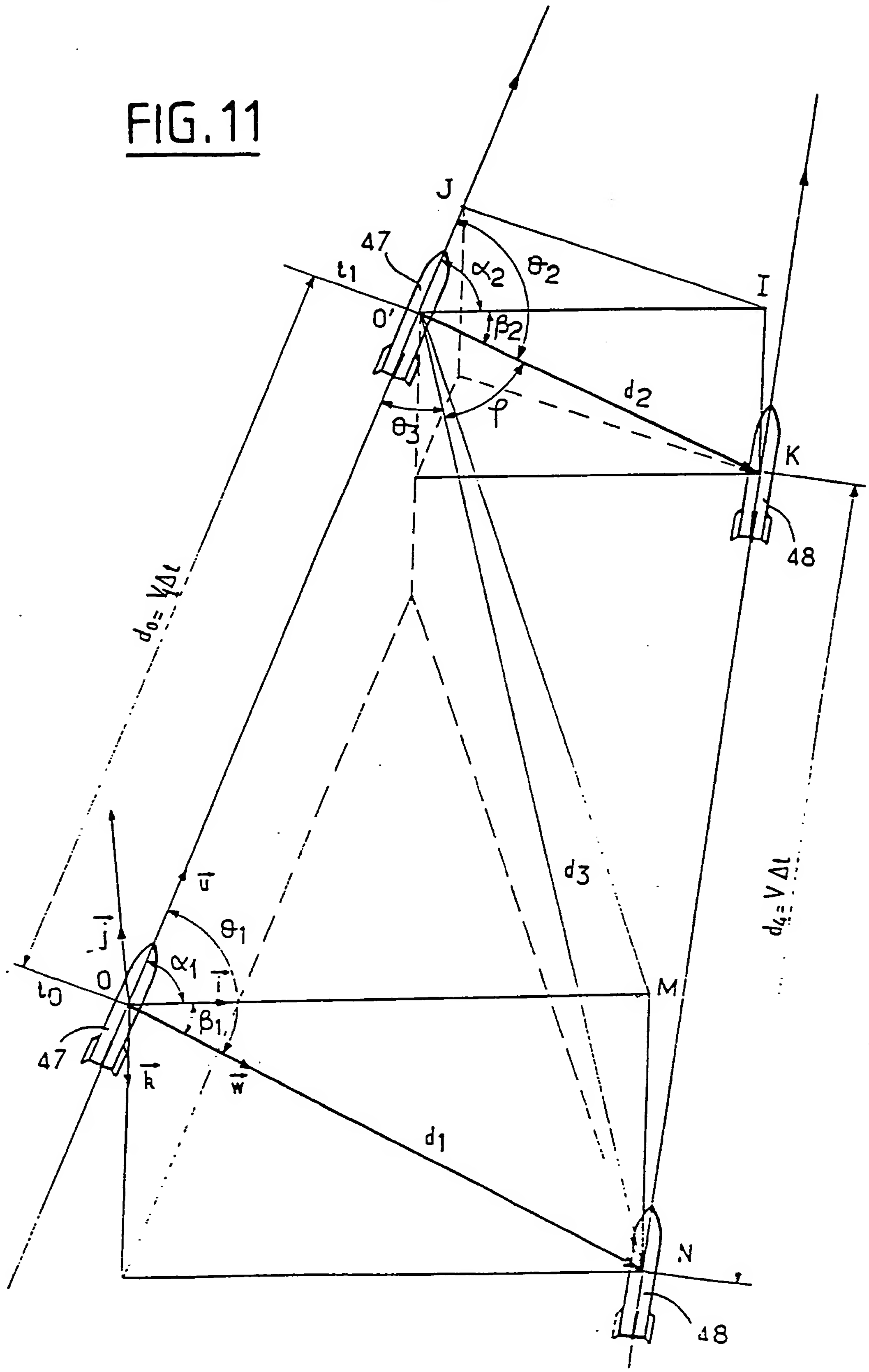


FIG.10

FIG.11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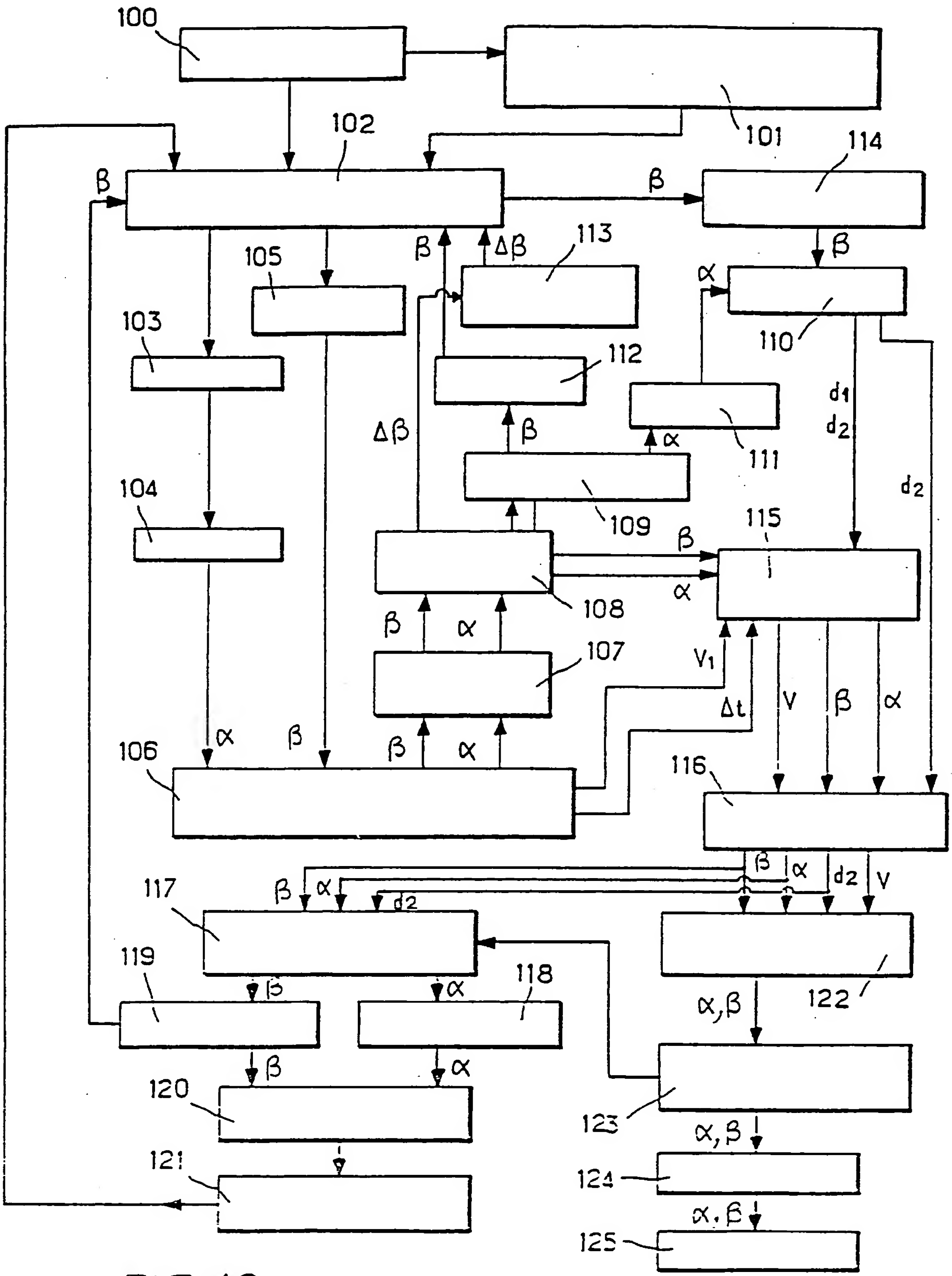
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FIG.12

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PATENTS ACT 1977

Description of Invention
"System for detecting and countering an aerial threat"

The present invention concerns a system for detecting and countering an aerial threat.

Such a system could be mounted on a land site or vehicle or on a ship, or even on board a flying machine, such as more particularly a missile, to allow protection of the said land site, or the said land, naval or aerial vehicle, especially with regard to missiles intended to destroy it.

The system for detecting and countering an aerial threat is, according to the invention, characterised in that it comprises:

- a carriage which is rotatable about an axis,
- means for driving the said carriage in rotation about the said axis,
- photosensitive means disposed in the interior of the said carriage and for observing the environment of the system through at least one observation window arranged in the peripheral external wall of the said carriage,
- telemetric means for measuring the distance separating the said system and the said threat, and means for attacking the said threat, the said telemetric means and the said attacking means being mounted in the said carriage,
- measuring means for indicating at each instant the angular position of the said carriage, and
- processing means receiving the information delivered by the said photosensitive means, the said measuring means and the said telemetric means and delivering commands to the said attacking means.

Thus, thanks to the field of the said photosensitive means in a plane passing through the centre of the said window and through the axis of rotation of the said carriage, it is possible to effect a detection of bearing, for example. Moreover, because of the rotation of this plane around the axis of rotation of the carriage, an angular position detection can also be obtained. The location of the assailant is refined with the aid of the telemetric means and the attacking means can then neutralise the said assailant.

It can be seen that it is sufficient, for a detection of bearing and angle of sight, for the said photosensitive means to observe at least the field contained in the rotating plane passing through the centre of the said window and through the axis of rotation of the said carriage.

To detect a threat which could be anywhere in relation to the system of the invention (when it is mounted on board a flying machine), it is advantageous if the said carriage rotates in a continuous fashion about its axis of rotation. However, in the case where the threat necessarily is located on only one side of the system, it could be sufficient for the said carriage to oscillate about its axis of rotation from one side to the other of a median position. This is for example the case when the system of the invention is mounted on the ground or on a ship, or even on board a flying machine, such as a missile, which flies at a very high altitude and must detect and neutralise enemy missiles arriving from below.

Preferably, the said photosensitive means are constituted by a plurality of individual detectors and an observation window is associated with each of the said individual detectors.

Advantageously, the said telemetric means are constituted by a telemeter laser and/or the said attacking means are constituted by a dazzling laser.

In particular, the sighting mechanism of the telemeter laser or of the dazzling laser could comprise a body presenting a toothed sector associated with a worm actuated by a stepping motor and, in this case, the optical means of the telemeter laser or the dazzling laser could be arranged in the said body of the sighting mechanism.

Preferably, the said carriage takes the form of a rotatable hollow ring.

When the system of the invention is mounted on board a flying machine, such as a missile, it is preferable for the said axis of rotation of the ring to be co-incident with the roll axis of the said flying machine.

In particular, the said ring may rotate about a shaft fixed to the said flying machine.

Preferably, the external peripheral wall of the said ring is at least substantially flush with the external wall of the body of the said flying machine.

The figures of the attached drawings will give a good understanding of how the invention can be put into practice.

Figure 1 is a schematic perspective view of one embodiment of the system according to the invention.

Figure 2 is a diametric section through the carriage of the system of Figure 1, through a plane passing through the axis of rotation of the carriage.

Figure 3 is a section of the carriage of the system of Figure 1, through a plane orthogonal to the axis of rotation of the said carriage.

Figures 4, 5 and 6 are respectively sections along the lines IV-IV, V-V and VI-VI of Figure 3.

Figures 7a to 7d illustrate an embodiment of the telemeter laser.

Figures 8a to 8d illustrate an embodiment of the dazzling laser.

Figure 9 illustrates the mounting of a system according to the invention on a flying machine, such as a missile.

Figure 10 illustrates the functioning of the system of the invention.

Figure 11 shows the evaluation of the speed of an attacker.

Figure 12 is a block diagram of the functioning of the system of the invention.

Referring to Figure 1, the system for detecting and countering an aerial threat comprises a carriage 1, presenting in this embodiment the general form of a hollow ring, which can rotate about an axis X, X extending along a first direction such that the carriage may effect

scanning more particularly for angular sighting, as indicated by the arrow 2. To this end, the carriage 1 comprises, in the vicinity of its centre, bearings 3, as well as journals 4 for mounting the carriage 1 symbolically represented on Figure 1.

As already indicated, the carriage 1 could be mounted on a land site or vehicle, on board a ship or even on board a flying machine, such as an artificial satellite, an observation or combat aircraft, or a missile. On the ground or on board a ship, the scanning about the axis X, X will be effected, in an alternating fashion through an angle of at least substantially 90° on either side of a median position, so as to cover a total scanning angle close to 180°. On the other hand, on board a flying machine, the scanning angle covered will be 360°, this being obtained either by continuous rotation of the carriage 1 through 360° about the axis X, X (in this case the axis of roll of the flying machine) or by alternating rotation about an intermediate position with an angular amplitude, in each case, of 180°.

In the external peripheral wall 5, the carriage 1 comprises:

- a first observation window 6, covering the forward sector A1 of the field of bearing observation, at an angle of about, for example, 50°, with which window are associated first photosensing means 22 (Figures 3 and 4),
- a second observation window 7, covering the central sector A2 of the field of bearing observation at an angle equal to, for example, 60°, with which window are associated second photosensing means 23 (Figures 3 and 5),

- a third observation window 8, covering the rear sector A3 of the field of bearing observation over an angle approximately equal to, for example, 50°, with which window are associated third photosensing means 24 (Figures 3 and 6).

Furthermore, there are provided in the peripheral wall 5 a window 9 for a telemeter laser 25 (Figure 3) and a window 10 for a dazzling laser 26 (Figure 3).

As can be seen in Figure 2, the carriage 1 is rotatably mounted, by means of the bearing 3, on a shaft 11 fixed to its mounting support (land site, ship, flying machine). In the illustrated example, for its driving around the shaft 11, the carriage 1 comprises a motor 12, fixed in rotation to the said carriage, and rotating a pinion 13 engaging with a toothed wheel 14 fixed to the shaft 11. The shaft 15 of the motor 12, on which the pinion 13 is keyed, is journalled in a frame 16 fixed to the carriage 1. The shaft 15 further fixed to an encoding disc 17 cooperating with an angular position coder 18 fixed to the carriage 1.

There is further provided an electrical supply arrangement 19 and an information processing device 20 fixed to the mounting support.

A rotating joint or collector arrangement 21 is also provided to permit electrical energisation of the photosensitive means, the telemeter laser, the dazzling laser and the motor 12 from the electrical supply 19, as well as for transmitting to the processing device 20 the information provided by the photosensitive means, the telemeter laser and the coder 18.

Figure 3 shows in cross-section, orthogonally to the axis X, X, the carriage 1 at the interior which are mounted the first, second and third photosensing means, respectively carrying the reference numerals 22, 23 and 24, associated with respective observation windows 6, 7 and 8, as well as the telemeter laser 25, associated with the window 9, and the dazzling laser 26, associated with the window 10.

As can be best seen in Figures 4 to 6, the window 6 - photosensing means 22 pair is orientated towards the front (by convention) of the mounting support, to encompass a part A1 of the field of observation. Similarly, the window 8 - photosensing means 24 pair is orientated towards the rear of the mounting support to encompass a part A3 of the field of observation. Finally, the window 7'-photosensing means 23 pair is orientated so as to encompass the middle part A2 of the field of observation. Thus, the field of observation is scanned, over practically 160°, by the addition of the information delivered by the photosensing means 22, 23 and 24.

Moreover, by the rotation of the photosensitive means and thus the field of observation (A1 + A2 + A3) about the axis X, X with the rotation of the carriage 1, the field of observation scans a large part of the environment of the mounting support of the carriage 1.

The photosensitive means are embodied, for example, in the form of arrays or matrices of CCD photosensitive elements, sensitive to infra-red radiation.

The impulsive telemeter laser is intended to provide the distance to the attacker and, possibly, to permit the approximate evaluation of its speed from two

consecutive measurements. The telemeter laser can serve to make known the distance from which one can use the dazzling laser whose output is less than that of the telemeter laser. It could equally be used as a disturber of the enemy detector, but at its wavelength of functioning, for example, 1.06 micrometers.

The aiming mechanism for the transmission axis of the laser beam of the telemeter 25 is illustrated in Figures 7a to d. The body or block 27 presents an external cylindrical form and is fixed to a cradle 28 on the exterior of which is fashioned a toothed sector 29, in a recess of the cradle 28 in which is lodged a worm 31, ensuring the angular displacement in bearing of the axis of transmission of the laser beam. Two sets of optics 32 and the transmitting and receiving sub-assemblies and chronometer are incorporated in the interior of the block.

Two trunnions 33 define the axis of rotation Y, Y, perpendicular to the axis X, X, of the telemeter, which trunnions are bored to enable the passage of wires for power supply and for controlling the laser firings.

The block 27 is decoupled from the internal structure of the carriage 1 by means of two bearings (not shown) mounted on the two trunnions 33. The angular movement of the optical axis of transmission of the laser beam is created by a stepping motor 34, with the aid of the worm 31 - toothed sector 29 pair, and the angle of rotation is controlled by an incremental generator 35, through a control card 36.

The angular course B1 of the aiming mechanism of course depends on the angular extent of the tooth sector 29 and may be, for example, about 110°.

As far as it is concerned, the dazzling laser presents a variable wavelength or an adaptable spectral band, in order that the transmission of its radiation falls within the detection band of the infra-red homing device of the attacker. The focusing of the energetic laser radiation by the optics of the enemy detector is such as to temporarily blind the latter, by saturating or damaging photosensitive elements. The homing device is thus dazzled and the guidance of the attacker is disturbed such that the latter may loose its target.

The aiming mechanism for the transmission axis of the dazzling laser 26, illustrated in Figures 8a - d, is analogous to that of the telemeter 25 of Figures 7a - d, with the exception of the fact that, in the latter case, a single optical transmission is provided. It thus occupies less space.

One thus again finds a cylindrical body or block 37 fixed to a cradle 38 presenting a toothed sector 39 in a recess 40 in which a worm 41 engages. The optical system 42 is integrated in the block 37. Similarly, two bored trunnions 43, on which bearings are mounted, ensure the passage of wires for power supply and control of the laser firings. Equally, the angular movement of the transmission axis of the laser is created by a stepping motor 44, and the angle of rotation is controlled by an incremental generator 45, through a control card 46.

The angular course B2 of the aiming mechanism can also be, for example, in the region of 110°.

As shown on Figure 9, the carriage 1 may be more particularly mounted on a flying machine, such as a missile 47, the axis X, X constituting in this case the roll axis

of the latter. The carriage 1 is constituted by a rotatable hollow ring which is flush with the external wall of the body of the missile and which is rotatable, about the axis X, X, continuously or in a back and forth alternating rotation. The assembly of the ring 1 on the missile 47 could be effected in different ways. The missile could be composed of two parts assembled together by means of the shaft passing through the ring or it could be in a single piece, while the ring is composed of two half rings diametrically assembled.

As illustrated in Figure 10, the processing arrangement 20, receiving the information from the photosensitive means 22, 23 and 24 and from the angular position coder 17, 18, can determine the co-ordinates of any missile around the missile 47, for example in the form of angular co-ordinates α and β illustrated on Figure 10. In effect, the photosensitive means indicate the position of the missile M in their field of observation (A1, A2, A3), while the coder 17, 18 indicates the position of this field around the axis X.X.

As indicated, the telemeter laser permits evaluation of the speed of an attacking missile. The speed V of the attacker is evaluated between two successive measurements of distance and direction (α, β), separated by the interval of time $\Delta t = t_1 - t_0$.

Figure 11 shows the trajectory of the missile 47 with respect to that of the attacker 48, in the interception phase.

At instant t_0, the system measures the distance d_1, missile/attacker, according to the direction characterised by the bearing angle $\alpha 1$ and the sighting angle $\beta 1$. At time

t_1, one similarly measures the distance d_2, missile/attacker, according to the direction characterised by the angles α_2, and β_2.

Let d_0 and d_4 be the distances travelled by the missile and the threat respectively between the two successive measurements. Assuming that during the time interval Δt, $166 \text{ ms} \leq \Delta t \leq 250 \text{ ms}$, the displacements of the two missiles are linear, this enables one to write:

$d_0 = V_1 \Delta t$ and $d_4 = V \Delta t$.

The velocity V_1 is known but not V:

$$V = \frac{d_4}{\Delta t} \tag{1}$$

To estimate the distance d_4, one considers the following simplifying hypotheses:

the sighting angle β varies little during Δt, so

$\beta_1 - \beta_2$

where the three angles below are situated in the same plane:

OO'N + NO'K + KO'J - 180°

$\theta_3 + \varphi + \theta_2 - 180°$

The distance travelled by the attacker can thus be expressed from the triangle KO'N :

$$d_4^2 = d_2^2 + d_3^2 - 2\, d_2\, d_3 \cos \varphi \tag{2}$$

From the triangle O'ON, one can equally deduce the relation:

$$d_3^2 = d_0^2 + d_1^2 - 2\, d_0\, d_1 \cos \theta_1 \tag{3}$$

If one expresses the two vectors $\vec{U}$ and $\vec{W}$ in the coordinate system $\vec{i}$ $\vec{j}$ and $\vec{k}$, one obtains:

$$\vec{U} = U \begin{vmatrix} \cos \alpha_1 \\ \sin \alpha_1 \\ 0 \end{vmatrix} \quad \text{and } \vec{W} = W \begin{vmatrix} \cos \beta_1 \\ 0 \\ -\sin \beta_1 \end{vmatrix}$$

and their scalar product:

$$\vec{U}\ \vec{W} = UW \cos\Theta_1 = UW \cos \alpha_1 \cos \beta_1$$

which enables the following expression to be written:

$$\cos \Theta_1 = \cos \alpha_1 \cos \beta_1 \tag{4}$$

One can similarly write:

$$\cos \Theta_2 = \cos \alpha_2 \cos \beta_2$$

where:

$$\Theta_2 = \text{Arccos} \ (\cos \alpha_2 \cos \beta_2) \tag{5}$$

From the triangle OO'N, one deduces the relationship

$$\cos \Theta_3 = \frac{d_0^2 + d_3^2 - d_1^2}{2\, d_0\, d_3}$$

By substitution from the equation (3) in this latter relationship and after simplification, one obtains:

$$\Theta_3 = \text{Arccos} \frac{d_0 - 2\, d_1 \cos \Theta_1}{\sqrt{d_0^2 + d_1^2 - 2\, d_0\, d_1 \cos \Theta_1}} \tag{6}$$

$$\varphi = 180° - \Theta_2 - \Theta_3 \qquad (7)$$

The distance travelled by the attacker can finally be written:

$$d_4^2 = d_0^2 + d_1^2 + d_2^2 - 2d_0 d_1 \cos\alpha_1 \cos\beta_1 \qquad (8)$$

$$-2d_2 \cos(180° - \Theta_2 - \Theta_3) \sqrt{d_0^2 + d_1^2 - 2d_0 d_1 \cos\alpha_1 \cos\beta_1}$$

The expressions (5), (6) and (8) enable evaluation of the distance travelled by the attacker and thus finally the parameter V . It is true that the exact calculation of this speed is difficult to obtain, because it is subject to the measurement errors of the eight parameters which are involved, moreover several times, in the three equations cited above. These entails an accumulation of errors in estimating the speed.

However, even an approximate knowledge, in default of a precise measurement, of the parameter V, could assist the system in the choice of the optimum instant for putting counter measures into practice, the initiation of an evasive manoeuvre or the firing of the dazzling laser.

Figure 12 is a schematic block diagram of the functioning of the system according to the invention.

The electrical supply arrangement 100 supplies, amongst other things, the driving mechanism 101 of the carriage (ring) 102, the optics 103, the detectors 104 and the incremental coder 105 of which provide the information (angular sighting position and bearing α, β) to the processing device 106. After confirmation of the threat 107, and taking account of the management of different

threats 108, the aiming means 109 of the telemeter 110 is commanded by the intermediary of the incremental generator 111 (α) and incremental generator 112 (β). An angular deviation control 113 is interposed between the processing device 106 and the carriage 102, and a laser firing control 114 between the carriage and the telemeter. The telemeter 110 enables evaluation of the speed of the attacker 115 and the location of the threat 116, and these parameters permit control of the aiming of the dazzling laser 117 with the assistance of the incremental generator 118 (α) and of the incremental generator 119 (β), and the laser firing control 120, before the detection of the following threat 121. The parameters 115 and 116 are further transmitted to the interface 122 which, after analysis, chooses (at 123) between decoying operations, evasive operations 125 or dazzling operations (117).

The system according to the invention assures the functions of monitoring, detection, possibly of pursuit, of location and dazzling of the attacker.

Any threat situated in the surveillance zone can be the object of a telemetric operation and then dazzling of the enemy infra-red homing device.

The range of the telemeter is short of the detection of the infra-red signal. One thus commences by evaluating the direction of the threat before attempting to measure the distance missile (for example) / attacker and then to extrapolate the speed of the threat.

In the phase of surveillance and detection, the system delivers the angular position of the attacker. In the location phase, the direction of the threat is completed by information on distance and speed. Knowledge

of the near flight of the attacker enables refinement of its location.

At a distance greater than the blinding distance of the enemy homing device, the system can initiate a dazzling operation against the detector of the attacker.

There will be given hereafter two examples of the functioning of this system in the case where it is mounted on a flying machine, such as a missile. The first example considers the carriage, or ring, to be in continuous rotation and the second assumes the carriage, or ring, to be in alternating rotation.

1. Carriage In Continuous Rotation

Surveillance Mode

It is assumed that in the course of its rotation and after having memorised the rear plane, the surveillance arrangement (photosensitive means) registers various signals. In this first stage, it is permitted to think that these points do not represent potential threats. These could be false alarms, or one or more attackers in a noisy environment.

After identification of signals having significant levels, those which exceed certain threshold are retained. Upon a second scanning, the direction (α_2, β_2) of the registered points are memorised for the second time. One then passes into the detection mode.

Detection Mode

A numeral filtering enables a first elimination of certain natural artifacts. One then discriminates the attackers of the non-filtered decoys, these in two way;

a) by logical processing. Various algrithms can be envisaged, a first approach would consist in retaining, after the third scanning, the signals whose intensity, form and direction (α_3, β_3) evolve in the sense of an approach relative to the flying machine carrying the system.

b) the hostiles missile can be separated from the environmental artifacts by spectral discrimination of the radiation collected by the arrays. After confirmation of the presence of one or more threats one passes into the location phase. In this second stage, the number of confirmed threats is substantially reduced.

Location Mode

Two configurations can be envisaged:

1. The detected attackers lie in the zone not covered by the telemeter. One cannot thus evaluate the distance and even less the speed of the threat. The system must then decide, on the basis of the single angular location (α_3, β_3), the instant for firing the counter measures or for the evasive manoeuvre.

2. The detected attackers are located in the zone covered by the telemeter. The designated threats are then processed sequentially, in the order in which there are presented during the rotation of the carriage (ring).

After confirmation of threats, there is transmitted, to the incremental generator of the telemeter, the bearing of the first threat with a view to immediately aiming the optical axis of the transmission laser at the

angle α_3, and the firing command for the laser is then synchronised with the instant the transmission axis reaches the angle of rotation β_3. Two situations can then be produced:

a) the telemeter measures no distance, whether because the attacker is beyond its actual range, or because the laser firing has lost the target. In this case, one goes on to the next threat and proceeds as before.

At the end of the fourth scanning and after re-determination of the direction (α_4, β_4), the telemetric measurement of the first threat is resumed. If the distance measurement cannot again be effected, one is brought back to the situation of the preceding paragraph.

b) the telemeter succeeds in delivering the distance information d_1. If the attacker is dangerously close to the flying machine (missile), it is suitable to immediately order evasion or the firing of counter measures.

If on the contrary the attacker is sufficiently remote, one awaits the next scanning to effect second distance measurement d_2, from which one deduces the approximate speed of the threat, according to the formulae indicated previously.

After analysis of the parameters d_2, V, α_5 and β_5, one can decide on a dazzling operation. In this case, one commands the aiming of the laser transmission axis according to the angle α_5 and, when it reaches the angle of rotation β_5, the firing of the laser is commanded in order to blind the autopilot of the attacker.

One then passes to the treatment of the second and any further threats.

2. <u>Carriage In Alternating Rotation</u>

The surveillance and detection procedures are similar to those described previously.

<u>Location Mode</u>

The confirmed threats are processed here in order of urgency. The alternating rotational movement of the ring is reduced to a scanning of the detection means involved, of some milliradians on one side and the other of the angle β_3 at which the priority attacker 1 has been detected.

After refining its location and determination of the new direction (α_4, β_4), the bearing of the threat is transmitted to the incremental generator of the telemeter. The transmission optical axis is then disposed at the angle α_4 and the ring is then displaced by the angle of rotation β_4, so as to align the laser transmission optical axis in coincidence with the presumed direction of the attacker, at the end of which a series of laser firings is immediately commanded. Two situations can occur:

a) the telemeter measures no distance, whether because the threat is outside its range, or because the laser firings have missed their target. According to the relative urgency of the priorities 1 and 2, one can decide to refine the evaluation of the direction of the threat of priority 1 and to renew the measurement of distance, or to pass directly to the localisation of the threat of priority 2 and to process later the attacker of priority 1.

b) The telemeter succeeds in measuring the distance of the attacker d_1 and then d_2, which enables approximate evaluation of the speed of the latter.

According to the amplitude of the parameters d_2 and V, one can judge the value of effecting other supplementary measurements in order to refine the location or on the contrary to initiate an evasive operation or a decoy operation against the attacker. In the latter case, the axis of the dazzling laser is pointed in the direction (α_4, β_4) of the attacker and the laser firings are then commanded in order to blind the enemy autopilot.

One then proceeds to processing the threat of priority 2 (or 1) and subsequent threats.

CLAIMS:

1. System for detecting and countering an aerial threat,
characterised in that it comprises:

- a carriage (1) which is rotatable about an axis (X, X),
- means (12) for driving the said carriage (1) in rotation about the said axis (X, X),
- photosensitive means (22, 23, 24) disposed in the interior of the said carriage (1) and for observing the environment of the said system through at least one observation window (6, 7, 8) arranged in the peripheral external wall (5) of the said carriage (1),
- telemetric means (25) for measuring the distance separating the said system and the said threat, and means (26) for attacking the said threat, the said telemetric means (25) and the said attacking means (26) being mounted in the said carriage (1),
- measuring means (17, 18) indicating at each instant the angular position of the said carriage (1), and
- processing means (20) receiving the information delivered by the said photosensitive means (22, 23, 24), the said measuring means (17, 18) and the said telemetric means (25), and delivering to the said attacking means (26).

2. System according to claim 1, characterised in that the said carriage (1) rotates in continuous fashion about its axis of rotation (X, X).

3. System according to claim 1, characterised in that the said carriage (1) oscillates about its axis of rotation (X, X) on one side and the other of a median position.

4. System according to one or more of claims 1 to 3, characterised in that the said photosensitive means (22, 23, 24) observe at least the field contained in the rotational plane passing through the centre of the said window (6, 7, 8) and through the axis of rotation (X, X) of the said carriage (1).

5. System according to one or more of claims 1 to 4, characterised in that the said photosensitive means (22, 23, 24) are constituted by a plurality of individual detectors, and in that an observation window (6,7, 8) is associated with each of the said individual detectors.

6. System according to one or more of claims 1 to 5, characterised in that the said telemetric means are constituted by a telemeter laser (25).

7. System according to one or more of claims 1 to 6, characterised in that the said attacking means are constituted by a dazzling laser (26).

8. System according to claim 6 or 7, characterised in that the aiming mechanism of the telemeter laser (25) or the dazzling laser (26) comprises a body (27, 37) presenting a tooth sector (28, 38) associated with a worm (31, 41) operated by a stepping motor (34, 44).

9. System according to claim 8, characterised in that the optical means (32, 42) of the telemeter laser (25) or of the dazzling laser (26) are arranged in the said body (27, 37) of the aiming mechanism.

10. System according to one or more of claims 1 to 9, characterised in that the said carriage is realised in the form of a hollow rotatable ring (1).

11. System according to claim 10, mounted on board a flying machine, such as a missile, characterised in that the said axis of rotation of the ring (1) is coincident with the roll axis (x, X) of the said flying machine (47).

12. System according to claim 11, characterised in that the said ring (1) rotates around a shaft (11) fixed to the said flying machine (47).

13. System according to claim 11 or 12, characterised in that the external peripheral wall (5) of the said ring (1) is at least substantially flush with the external wall of the body of the said flying machine (47).

14. A system for detecting and countering an aerial threat substantially as hereinbefore described with reference to the accompanying drawings.

15. Any novel feature or combination of features described herein.

Amendments to the claims have been filed as follows

1. A system for detecting and countering an aerial threat, comprising:

a carriage (1) which is rotatable about an axis (X, X),

means (12) for driving the said carriage (1) in rotation about the said axis (X, X),

photosensitive means (22, 23, 24) disposed in the interior of the said carriage (1) and for observing the environment of the said system through at least one observation window (6, 7, 8) arranged in the peripheral external wall (5) of the said carriage (1),

telemetric means (25) for measuring the distance separating the said system and the said threat, and means (26) for attacking the said threat, the said telemetric means (25) and the said attacking means (26) being mounted in the said carriage (1),

measuring means (17, 18) indicating at each instant the angular position of the said carriage (1), and

processing means (20) receiving the information delivered by the said photosensitive means (22, 23, 24), the said measuring means (17, 18) and the said telemetric means (25), and delivering commands to the said attacking means (26),

in which system the said photosensitive means (22, 23, 24) observe the field contained in the rotational plane passing through the centre of the said window (6, 7 8) and through the axis of rotation (X, X) of the said carriage (1).

2. A system according to claim 1, in which the said carriage (1) is rotated in continuous fashion about its axis of rotation (X, X).

3. A system according to claim 1, in which the said carriage (1) is oscillated about its axis of rotation (X, X) on one side and the other of a median position.

4. A system according to any one of claims 1 to 3, in which the said photosensitive means (22, 23, 24) are constituted by a plurality of individual detectors, and in that an observation window (6,7, 8) is associated with each of the said individual detectors.

5. A system according to any one of claims 1 to 4, in which the said telemetric means are constituted by a telemeter laser (25).

6. A system according to any one of claims 1 to 5, in which the said attacking means are constituted by a dazzling laser (26).

7. A system according to claim 5 or 6, in which the aiming mechanism of the telemeter laser (25) or the dazzling laser (26) comprises a body (27, 37) presenting a tooth sector (28, 38) associated with a worm (31, 41) operated by a stepping motor (34, 44).

8. A system according to claim 7, in which the optical means (32, 42) of the telemeter laser (25) or of the dazzling laser (26) are arranged in the said body (27, 37) of the aiming mechanism.

9. A system according to any one of claims 1 to 8, in which the said carriage is realised in the form of a hollow rotatable ring (1).

10. A system according to claim 9, mounted on board a flying machine, such as a missile, in which the said axis

of rotation of the ring (1) is coincident with the roll axis (x, X) of the said flying machine (47).

11. A system according to claim 10, in which the said ring (1) is rotated around a shaft (11) fixed to the said flying machine (47).

12. A system according to claim 10 or 11, in which the external peripheral wall (5) of the said ring (1) is at least substantially flush with the external wall of the body of the said flying machine (47).

13. A system for detecting and countering an aerial threat substantially as hereinbefore described with reference to the accompanying drawings.

2b

Patents Act 1977
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Relevant Technical fields

(i) UK Cl (Edition K) F3C CGB, CAJ, CBB, CBA H4D DLAB, DLFR

(ii) Int Cl (Edition 5) F41H 11/00, 11/02 F41G 3/00, 306, 306B

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Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

22 JANUARY 1992

Documents considered relevant following a search in respect of claims

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	EP-0089273-A1 (THOMSON-CSF) - whole document	1
X	EP-0054489-A1 (SOPELEM) - whole document	1
X	EP-0033679-A1 (THOMSON-CSF) - whole document	1

SF2(p)

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

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